

# Knowledge Management and Artificial Intelligence and Expert Systems

## Syllabus Topic : Introduction to Knowledge Management

### 5.1 Introduction to Knowledge Management

**Q. 5.1.1 Explain Knowledge management. (Ref. Sec. 5.1)**

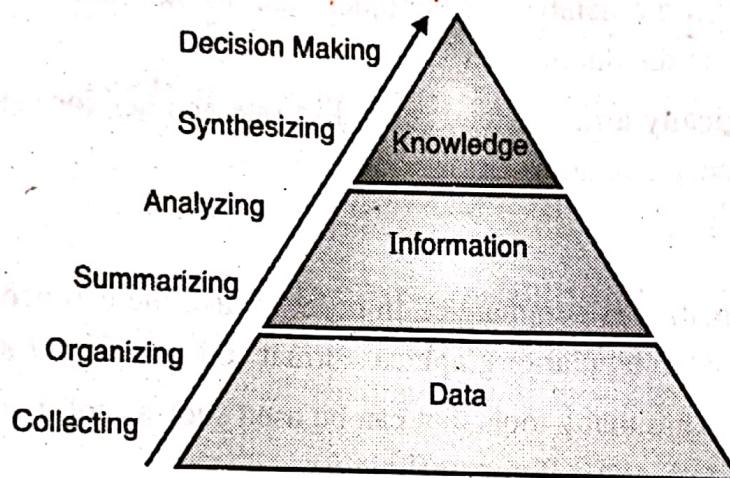
**(5 Marks)**

- Knowledge management is an activity practised by enterprises all over the world. In the process of knowledge management, these enterprises comprehensively gather information using many methods and tools.
- Then, gathered information is organized, stored, shared, and analysed using defined techniques. The analysis of such information will be based on resources, documents, people and their skills.
- Properly analysed information will then be stored as 'knowledge' of the enterprise. This knowledge is later used for activities such as organizational decision making and training new staff members.
- There have been many approaches to knowledge management from early days. Most of early approaches have been manual storing and analysis of information.
- With the introduction of computers, most organizational knowledge and management processes have been automated.
- Therefore, information storing, retrieval and sharing have become convenient. Nowadays, most enterprises have their own knowledge management framework in place.
- The framework defines the knowledge gathering points, gathering techniques, tools used, data storing tools and techniques and analysing mechanism.

### 5.1.1 The Knowledge Management Process

- Q. 5.1.2** Explain knowledge management process. (Ref. Sec. 5.1.1) **(5 Marks)**
- Q. 5.1.3** Write short note on approaches knowledge management. (Ref. Sec. 5.1.1) **(5 Marks)**

- The process of knowledge management is universal for any enterprise. Sometimes, the resources used, such as tools and techniques, can be unique to the organizational environment.
- The Knowledge Management process has six basic steps assisted by different tools and techniques. When these steps are followed sequentially, the data transforms into knowledge.



**Fig. 5.1.1**

#### Step 1 : Collecting

- This is the most important step of the knowledge management process. If you collect the incorrect or irrelevant data, the resulting knowledge may not be the most accurate. Therefore, the decisions made based on such knowledge could be inaccurate as well.
- There are many methods and tools used for data collection. First of all, data collection should be a procedure in knowledge management process. These procedures should be properly documented and followed by people involved in data collection process.
- The data collection procedure defines certain data collection points. Some points may be the summary of certain routine reports. As an example, monthly sales report and daily attendance reports may be two good resources for data collection.
- With data collection points, the data extraction techniques and tools are also defined. As an example, the sales report may be a paper-based report where a data entry operator



needs to feed the data manually to a database whereas, the daily attendance report may be an online report where it is directly stored in the database.

- In addition to data collecting points and extraction mechanism, data storage is also defined in this step. Most of the organizations now use a software database application for this purpose.

### Step 2 : Organizing

- The data collected need to be organized. This organization usually happens based on certain rules. These rules are defined by the organization.
- As an example, all sales-related data can be filed together and all staff-related data could be stored in the same database table. This type of organization helps to maintain data accurately within a database.
- If there is much data in the database, techniques such as 'normalization' can be used for organizing and reducing the duplication.
- This way, data is logically arranged and related to one another for easy retrieval. When data passes step 2, it becomes information.

### Step 3 : Summarizing

- In this step, the information is summarized in order to take the essence of it. The lengthy information is presented in tabular or graphical format and stored appropriately.
- For summarizing, there are many tools that can be used such as software packages, charts (Pareto, cause-and-effect), and different techniques.

### Step 4 : Analyzing

- At this stage, the information is analyzed in order to find the relationships, redundancies and patterns.
- An expert or an expert team should be assigned for this purpose as the experience of the person/team plays a vital role. Usually, there are reports created after analysis of information.

### Step 5 : Synthesizing

- At this point, information becomes knowledge. The results of analysis (usually the reports) are combined together to derive various concepts and artefacts.
- A pattern or behavior of one entity can be applied to explain another, and collectively, the organization will have a set of knowledge elements that can be used across the organization.
- This knowledge is then stored in the organizational knowledge base for further use.

- Usually, the knowledge base is a software implementation that can be accessed from anywhere through the Internet.
- You can also buy such knowledge base software or download an open-source implementation of the same for free.

### Step 6 : Decision Making

- At this stage, the knowledge is used for decision making. As an example, when estimating a specific type of a project or a task, the knowledge related to previous estimates can be used.
- This accelerates the estimation process and adds high accuracy. This is how the organizational knowledge management adds value and saves money in the long run.

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### Syllabus Topic : Roles of People in Knowledge Management

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## 5.2 Roles of People in Knowledge Management

**Q. 5.2.1** What are the role of knowledge management? (Ref. Sec. 5.2)

**(5 Marks)**

- People are ultimately **the holders of knowledge**. The goal is to encourage them to not only search for it and improve it for applying it to improving internal processes, but to make them see the benefits of sharing it with the organization, in this context it is important:
  1. To give people **autonomy** in their jobs and find new ways to **fulfill them**.
  2. To provide proper storage and **sharing of knowledge systems**.
  3. To **empower them** and continually train them
  4. To keep them **motivated**
  5. To give them adequate **remuneration**, to ensure their commitment.
- The manager should always be aware of the fact that decisions made by people can affect the entire organization.
- That's why your motivation is crucial, that's what will make employees share and replicate the knowledge they accumulate in their activities in the company with colleagues.
- The worst that can happen is to lose that talent to the competition, along with everything they have learned.

## Syllabus Topic : Organizational Learning

### 5.3 Learning Organisation

**Q. 5.3.1** Write short note on learning organization. (Ref. Sec. 5.3)

**(5 Marks)**

- The learning organisation is an organisation characterised by a deep commitment to learning and education with the intention of continuous improvement.
- This concept reviews several theories relating to the learning organisation, including some criticism.
- Also, it examines some evidence on how learning organisations operate. Learning organisations facilitate collective learning in order to continually improve the capacity to respond to changing demands in the environment.
- This permeates all organisational activities, structures, processes, climate and values, leading to an enhanced ability to react quickly to opportunities and threats.

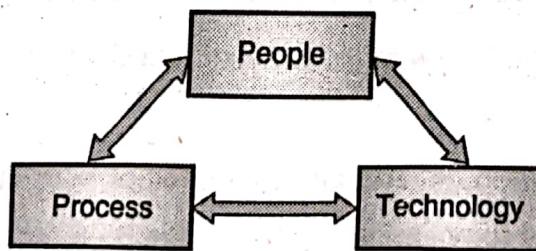
## Syllabus Topic : Organizational Transformation

### 5.4 Organizational Transformation

**Q. 5.4.1** Write short note on Organizational transformation. (Ref. Sec. 5.4)

**(5 Marks)**

- Organizational transformation takes place when there is a change in the way the business is done or in the event of a re-engineering or restructuring activity.
- Along with the structural changes, the attitude of the employees, their perspectives as well as the culture of the organization undergoes a significant change.
- It's about re-modelling an organization in its entirety.



**Fig. 5.4.1**

There are three key stages for managing organisational transformation along with the critical success factors for managing change at each stage.

### Stage 1 : Break with the past

- Bring in outsiders. The Board should introduce entrepreneurial outsiders with targeted expertise onto the top management team.
- Break with your administrative heritage. Important mechanisms here can be the removal of blockers, rotation of managers, promotion of young managers untainted by the organisational heritage, the utilisation of project teams, the achievement of early successes and designing a suitable bonus/incentive system.
- Use aspects of the administrative heritage that help the change process. Not everything that worked in the past needs to be thrown away.
- This will vary from company to company. Some may be able leverage a traditional command-and-control management style to achieve more rapid implementation of change; however, in environments where a more democratic leadership style is the norm, it may be more appropriate to leverage other factors, for example, customer relationships, a strong R&D department, or the latent enthusiasm of organisational members for participating in new initiatives. Crisis is also an important lever for organisational change.

### Stage 2 : Manage the present

- Vary your leadership style as appropriate. The top-down approach of Stage 1 may be still required to break with the past in some parts of the organisation, while other parts may by this stage already have the ability to learn and therefore may be given authority and empowerment to act.
- Exploit best practice from your own or other organisations. This will require knowledge acquisition, knowledge internalisation and knowledge dissemination.
- Reconfigure, divest and integrate resources. This involves everything from streamlining business systems to removing non-aligned employees to consolidating new acquisitions operationally and culturally.

### Stage 3: Invest in the future

- Empower the organisation. The top management team should delegate to employees as well as motivating and enabling them to act.
- Enable the organisation to engage in exploration of new ideas and business practices. You can achieve this by encouraging innovation, trial and experimentation and by developing a culture which encourages informed risk-taking and facilitates learning from mistakes. Exploration enables the organisation to develop new capabilities fitted to its specific context, rather than just importing systems and routines from other contexts.

Create new paths. This means creating a deliberate change in direction using new capabilities, whether that be in terms of new products, services, processes or business models.

The combination of exploration and path creation will lead you to the “disruptive innovation” that will help you secure sustainable competitive advantage.

By going through these stages, organizations can establish new developmental pathways, enhance their strategic flexibility, and react successfully to changes in the environment.

### **Syllabus Topic : Knowledge Management Activities**

#### **5.5 Knowledge Management Activities**

**Q. 5.5.1 Explain knowledge management activities in brief. (Ref. Sec. 5.5) (5 Marks)**

- A winning knowledge management program increases staff productivity, product and service quality, and deliverable consistency by capitalizing on intellectual and knowledge-based assets.
- Many organizations leap into a knowledge management solution (e.g. document management, data mining, blogging, and community forums) without first considering the purpose or objectives they wish to fulfill or how the organization will adopt and follow best practices for managing its knowledge assets long term.

A successful knowledge management program will consider more than just technology. An organization should also consider:

- **People** : They represent how you increase the ability of individuals within the organization to influence others with their knowledge.
- **Processes** : They involve how you establish best practices and governance for the efficient and accurate identification, management, and dissemination of knowledge.
- **Technology** : It addresses how you choose, configure, and utilize tools and automation to enable knowledge management.
- **Structure** : It directs how you transform organizational structures to facilitate and encourage cross-discipline awareness and expertise.
- **Culture** : It embodies how you establish and cultivate a knowledge-sharing, knowledge-driven culture.

##### **5.5.1 The Power of Knowledge Management**

- Implementing a complete knowledge management takes time and money, however, the results can be impressive and risks can be minimized by taking a phased approach that gives beneficial returns at each step.

- Organizations that have made this kind of investment in knowledge management realize tangible results quickly.
- They add to their top and bottom lines through faster cycle times, enhanced efficiency, better decision making and greater use of tested solutions across the enterprise.

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**Syllabus Topic : Approaches to Knowledge Management**

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**5.6 Approaches to Knowledge Management**

Approaches to Knowledge Management are explained in **Section 5.1.1.**

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**Syllabus Topic : Information Technology (IT) in Knowledge Management**

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**5.7 Information Technology (IT) in Knowledge Management**

**Q. 5.7.1 Explain IT in knowledge management.(Ref. Sec. 5.7)**

**(5 Marks)**

- KM was initially driven primarily by IT, information technology, and the desire to put that new technology, the Internet, to work and see what it was capable of.
- That first stage has been described using a horse breeding metaphor as “by the internet out of intellectual capital,” the sire and the dam.
- The concept of intellectual capital, the notion that not just physical resources, capital, and manpower, but also intellectual capital (knowledge) fueled growth and development, provided the justification, the framework, and the seed. The availability of the internet provided the tool.
- As described above, the management consulting community jumped at the new capabilities provided by the Internet, using it first for themselves, realizing that if they shared knowledge across their organization more effectively they could avoid reinventing the wheel, underbid their competitors, and make more profit.
- The central point is that the first stage of KM was about how to deploy that new technology to accomplish more effective use of information and knowledge.

The first stage might be described as the “If only Texas Instruments knew what Texas Instruments knew” stage, to revisit a much quoted KM mantra. The hallmark phrase of Stage 1 was first “best practices,” later replaced by the more politic “lessons learned.”

**Syllabus Topic : Knowledge Management Systems Implementation****5.8 Knowledge Management Systems Implementation**

**Q. 5.8.1** Write steps involved in knowledge management system implementation.  
(Ref. Sec. 5.8)

**(5 Marks)****Steps to Implementation**

Implementing a knowledge management program is no easy feat. You will encounter many challenges along the way including many of the following:

- Inability to recognize or articulate knowledge; turning tacit knowledge into explicit knowledge.
- Geographical distance and/or language barriers in an international company.
- Limitations of information and communication technologies.
- Loosely defined areas of expertise.
- Internal conflicts (e.g. professional territoriality).
- Lack of incentives or performance management goals.
- Poor training or mentoring programs.
- Cultural barriers (e.g. "this is how we've always done it" mentality).

The following eight-step approach will enable you to identify these challenges so you can plan for them, thus minimizing the risks and maximizing the rewards. This approach was developed based on logical, tried-and-true activities for implementing any new organizational program. The early steps involve strategy, planning, and requirements gathering while the later steps focus on execution and continual improvement.

**Step 1 : Establish Knowledge Management Program Objectives**

- Before selecting a tool, defining a process, and developing workflows, you should envision and articulate the end state.
- In order to establish the appropriate program objectives, identify and document the business problems that need resolution and the business drivers that will provide momentum and justification for the endeavor.
- Provide both short-term and long-term objectives that address the business problems and support the business drivers. Short-term objectives should seek to provide validation that the program is on the right path while long-term objectives will help to create and communicate the big picture.

### Step 2 : Prepare for Change

- Knowledge management is more than just an application of technology. It involves cultural changes in the way employees perceive and share knowledge they develop or possess.
- One common cultural hurdle to increasing the sharing of knowledge is that companies primarily reward individual performance.
- This practice promotes a "knowledge is power" behavior that contradicts the desired knowledge-sharing, knowledge-driven culture end state you are after.
- Successfully implementing a new knowledge management program may require changes within the organization's norms and shared values; changes that some people might resist or even attempt to quash.
- To minimize the negative impact of such changes, it's wise to follow an established approach for managing cultural change.

### Step 3 : Define High-Level Process

- To facilitate the effective management of your organization's knowledge assets, you should begin by laying out a high-level knowledge management process.
- The process can be progressively developed with detailed procedures and work instructions throughout steps four, five, and six. However, it should be finalized and approved prior to step seven (implementation).
- Organizations that overlook or loosely define the knowledge management process will not realize the full potential of their knowledge management objectives.
- How knowledge is identified, captured, categorized, and disseminated will be ad hoc at best. There are a number of knowledge management best practices, all of which comprise similar activities.
- In general, these activities include knowledge strategy, creation, identification, classification, capture, validation, transfer, maintenance, archival, measurement, and reporting.

### Step 4 : Determine and Prioritize Technology Needs

- Depending on the program objectives established in step one and the process controls and criteria defined in step three, you can begin to determine and prioritize your knowledge management technology needs.
- With such a variety of knowledge management solutions, it is imperative to understand the cost and benefit of each type of technology and the primary technology providers in the marketplace.

- Don't be too quick to purchase a new technology without first determining if your existing technologies can meet your needs.
- You can also wait to make costly technology decisions after the knowledge management program is well underway if there is broad support and a need for enhanced computing and automation.

### Step 5: Assess Current State

- Now that you've established your program objectives to solve your business problem, prepared for change to address cultural issues, defined a high-level process to enable the effective management of your knowledge assets, and determined and prioritized your technology needs that will enhance and automate knowledge management related activities, you are in a position to assess the current state of knowledge management within your organization.
- The knowledge management assessment should cover all five core knowledge management components: people, processes, technology, structure, and culture.
- A typical assessment should provide an overview of the assessment, the gaps between current and desired states, and the recommendations for attenuating identified gaps. The recommendations will become the foundation for the roadmap in step six.

### Step 6 : Build a Knowledge Management Implementation Roadmap

- With the current-state assessment in hand, it is time to build the implementation roadmap for your knowledge management program.
- But before going too far, you should re-confirm senior leadership's support and commitment, as well as the funding to implement and maintain the knowledge management program.
- Without these prerequisites, your efforts will be futile. Having solid evidence of your organization's shortcomings, via the assessment, should drive the urgency rate up.
- Having a strategy on how to overcome the shortcomings will be critical in gaining leadership's support and getting the funding you will need.
- This strategy can be presented as a roadmap of related projects, each addressing specific gaps identified by the assessment.
- The roadmap can span months and years and illustrate key milestones and dependencies. A good roadmap will yield some short-term wins in the first step of projects, which will bolster support for subsequent steps.
- As time progresses, continue to review and evolve the roadmap based upon the changing economic conditions and business drivers.



- You will undoubtedly gain additional insight through the lessons learned from earlier projects that can be applied to future projects as well.

### **Step 7: Implementation**

- Implementing a knowledge management program and maturing the overall effectiveness of your organization will require significant personnel resources and funding.
- Be prepared for the long haul, but at the same time, ensure that incremental advances are made and publicized.
- As long as there are recognized value and benefits, especially in light of ongoing successes, there should be little resistance to continued knowledge management investments.
- With that said, it's time for the rubber to meet the road. You know what the objectives are. You have properly mitigated all cultural issues.
- You've got the processes and technologies that will enable and launch your knowledge management program. You know what the gaps are and have a roadmap to tell you how to address them.
- As you advance through each step of the roadmap, make sure you are realizing your short-term wins. Without them, your program may lose momentum and the support of key stakeholders.

### **Step 8 : Measure and Improve the Knowledge Management Program**

- How will you know your knowledge management investments are working? You will need a way of measuring your actual effectiveness and comparing that to anticipated results.
- If possible, establish some baseline measurements in order to capture the before shot of the organization's performance prior to implementing the knowledge management program.
- Then, after implementation, trend and compare the new results to the old results to see how performance has improved.
- Don't be disillusioned if the delta is not as large as you would have anticipated. It will take time for the organization to become proficient with the new processes and improvements. Over time, the results should follow suit.
- When deciding upon the appropriate metrics to measure your organization's progress, establish a balanced scorecard that provides metrics in the areas of performance, quality, compliance, and value.
- The key point behind establishing a knowledge management balanced scorecard is that it provides valuable insight into what's working and what's not.

- You can then take the necessary actions to mitigate compliance, performance, quality, and value gaps, thus improving overall efficacy of the knowledge management program.

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### **Syllabus Topic : Concepts and Definitions of Artificial Intelligence**

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## **5.9 Introduction to Artificial Intelligence**

**Q. 5.9.1 What is Artificial Intelligence? (Ref. Sec. 5.9)**

**(5 Marks)**

- Since the invention of computers or machines, their capability to perform various tasks went on growing exponentially.
- Humans have developed the power of computer systems in terms of their diverse working domains, their increasing speed, and reducing size with respect to time.
- A branch of Computer Science named Artificial Intelligence pursues creating the computers or machines as intelligent as human beings.
- According to the father of Artificial Intelligence, John McCarthy, it is "The science and engineering of making intelligent machines, especially intelligent computer programs".
- Artificial Intelligence is a way of making a computer, a computer-controlled robot, or a software think intelligently, in the similar manner the intelligent humans think.
- AI is accomplished by studying how human brain thinks, and how humans learn, decide, and work while trying to solve a problem, and then using the outcomes of this study as a basis of developing intelligent software and systems.

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### **Syllabus Topic : Artificial Intelligence Versus Natural Intelligence**

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## **5.10 Differences Between Artificial Intelligence and Human Intelligence**

**Q. 5.10.1 Differentiate between human intelligence and artificial intelligence.**

**(Ref. Sec. 5.10)**

**(5 Marks)**

- Intelligence can be defined as a general mental ability for reasoning, problem-solving, and learning. Because of its general nature, intelligence integrates cognitive functions such as perception, attention, memory, language, or planning.
- On the basis of this definition, intelligence can be reliably measured by standardized tests with obtained scores predicting several broad social outcomes such as educational achievement, job performance, health, and longevity. So let's study the differences between Artificial Intelligence and Human Intelligence in a detail.



### ☞ Artificial Intelligence

- Artificial Intelligence is the study and design of Intelligent agent, These intelligent agents have the ability to analyze the environments and produce actions which maximize success.
- AI research uses tools and insights from many fields, including computer science, psychology, philosophy, neuroscience, cognitive science, linguistics, operations research, economics, control theory, probability, optimization and logic.
- AI research also overlaps with tasks such as robotics, control systems, scheduling, data mining, logistics, speech recognition, facial recognition and many others.

### ☞ Human Intelligence

- Human Intelligence is defined as the quality of the mind that is made up of capabilities to learn from past experience, adaptation to new situations, handling of abstract ideas and the ability to change his/her own environment using the gained knowledge.
- Human Intelligence can provide several kinds of information. It can provide observations during travel or other events from travellers, refugees, escaped friendly POWs, etc.
- It can provide data on things about which the subject has specific knowledge, which can be another human subject, or, in the case of defectors and spies, sensitive information to which they had access. Finally, it can provide information on interpersonal relationships and networks of interest.

### ☞ Key Differences between Artificial Intelligence and Human Intelligence

Below are the lists of points, describe the key Differences between Artificial Intelligence and Human Intelligence.

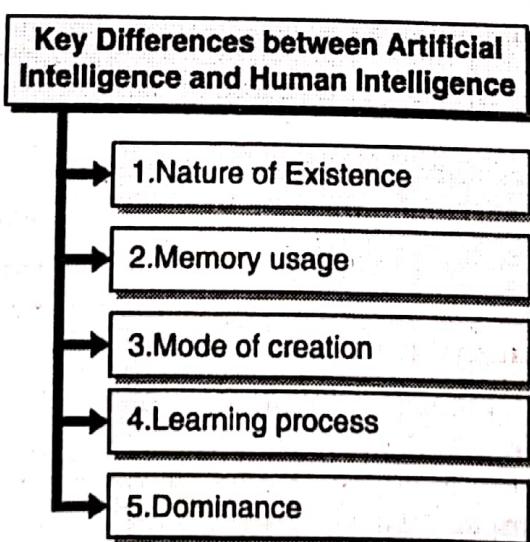


Fig. 5.10.1 : Key Differences between Artificial Intelligence and Human Intelligence

**→ 1. Nature of Existence**

Human intelligence revolves around adapting to the environment using a combination of several cognitive processes. The field of Artificial intelligence focuses on designing machines that can mimic human behaviour.

**→ 2. Memory usage**

Humans use content memory and thinking whereas, robots are using the built-in instructions, designed by scientists.

**→ 3. Mode of creation**

Human intelligence is bigger because its creation of God and artificial intelligence as the name suggests is artificial, little and temporary created by humans. Also, Humans intelligence is the real creator of the artificial intelligence even but they cannot create a human being with superiority.

**→ 4. Learning process**

- Human intelligence is based on the variants they encounter in life and responses they get which may result in millions of functions overall in their lives.
- However, for Artificial intelligence is defined or developed for specific tasks only and its applicability on other tasks may not be easily possible.

**→ 5. Dominance**

Artificial intelligence can beat human intelligence in some specific areas such as in Chess a supercomputer has beaten the human player due to being able to store all the moves played by all humans so far and being able to think ahead 10 moves as compared to human players who can think 10 steps ahead but cannot store and retrieve that number of moves in Chess.

Sr. No.	Comparison Factor	Human Intelligence	Artificial Intelligence
1.	Energy efficiency	25 watts human brain	2 watts for modern machine learning machine.
2.	Universal	Humans usually learn how to manage hundreds of different skills during life.	While consuming kilowatts of energy, this machine is usually designed for a few tasks.
3.	Multitasking	Human worker work on multiple responsibilities.	The time needed to teach system on each and every response is considerably high.

Sr. No.	Comparison Factor	Human Intelligence	Artificial Intelligence
4.	<b>Decision Making</b>	Humans have the ability to learn decision making from experienced scenarios.	Even the most advanced robots can hardly compete in mobility with 6 years old child. And this results we have after 60 years of research and development.
5.	<b>State</b>	Brains are Analogue	Computers are digital

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### Syllabus Topic : Basic Concepts of Expert Systems

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## 5.11 Basic Concepts of Expert Systems

**Q. 5.11.1** Explain basic concepts of expert systems. (Ref. Sec. 5.11) **(5 Marks)**

**Q. 5.11.2** What are expert systems? (Ref. Sec. 5.11) **(5 Marks)**

Expert Systems (ES) are one of the prominent research domains of AI. It is introduced by the researchers at Stanford University, Computer Science Department.

The expert systems are the computer applications developed to solve complex problems in a particular domain, at the level of extra-ordinary human intelligence and expertise.

#### ☞ **Characteristics of Expert Systems**

- High performance.
- Understandable.
- Reliable.
- Highly responsive.

#### ☞ **Capabilities of Expert Systems**

The expert systems are capable of :

- Advising.
- Instructing and assisting human in decision making.
- Demonstrating.
- Deriving a solution.
- Diagnosing.
- Explaining.

- Interpreting input.
- Predicting results.
- Justifying the conclusion.
- Suggesting alternative options to a problem.

#### ☞ In Capabilities of Expert Systems

They are incapable of :

- Substituting human decision makers.
- Possessing human capabilities.
- Producing accurate output for inadequate knowledge base.
- Refining their own knowledge.

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### Syllabus Topic : Structure of Expert Systems

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## 5.12 Components of Expert Systems

**Q. 5.12.1 Explain components of expert system. (Ref. Sec. 5.12)**

**(5 Marks)**

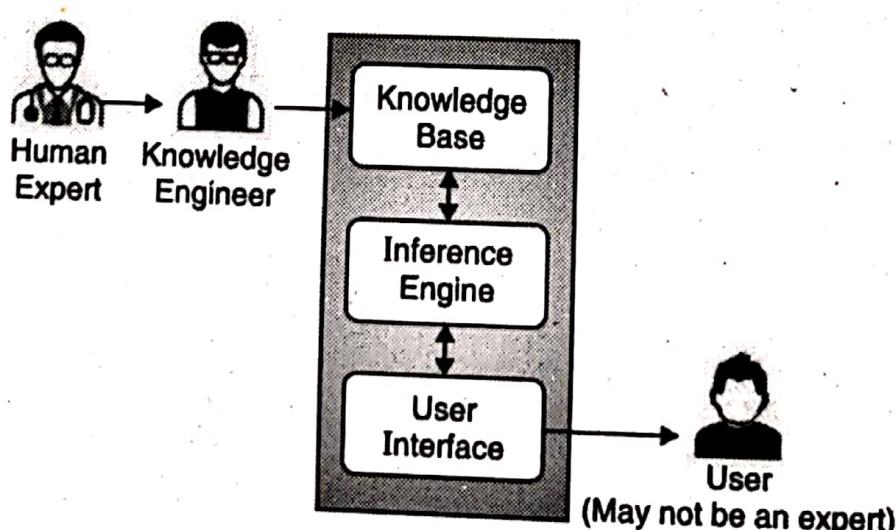
**Q. 5.12.2 Explain structure of expert systems. (Ref. Sec. 5.12)**

**(5 Marks)**

The components of ES include :

- Knowledge Base.
- Inference Engine.
- User Interface.

Let us see them one by one briefly :



**Fig. 5.12.1**

## Syllabus Topic : Knowledge Engineering

### 5.12.1 Knowledge Base

#### Q. 5.12.3 What is Knowledge? (Ref. Sec. 5.12.1)

(5 Marks)

- It contains domain-specific and high-quality knowledge.
- Knowledge is required to exhibit intelligence. The success of any ES majorly depends upon the collection of highly accurate and precise knowledge.

The data is collection of facts. The information is organized as data and facts about the task domain. **Data, information, and past experience** combined together are termed as knowledge.

#### 5.12.1.1 Components of Knowledge Base

#### Q.5.12.4 Explain forward chaining and backward chaining. (Ref. Sec. 5.12.1.1) (5 Marks)

The knowledge base of an ES is a store of both, factual and heuristic knowledge.

- **Factual Knowledge** : It is the information widely accepted by the Knowledge Engineers and scholars in the task domain.
- **Heuristic Knowledge** : It is about practice, accurate judgement, one's ability of evaluation, and guessing.
- **Knowledge representation**

It is the method used to organize and formalize the knowledge in the knowledge base. It is in the form of IF-THEN-ELSE rules.

#### ☞ Knowledge acquisition

- The success of any expert system majorly depends on the quality, completeness, and accuracy of the information stored in the knowledge base.
- The knowledge base is formed by readings from various experts, scholars, and the **Knowledge Engineers**. The knowledge engineer is a person with the qualities of empathy, quick learning, and case analyzing skills.
- He acquires information from subject expert by recording, interviewing, and observing him at work, etc. He then categorizes and organizes the information in a meaningful way, in the form of IF-THEN-ELSE rules, to be used by inference machine. The knowledge engineer also monitors the development of the ES.

### 5.12.2 Inference engine

- Use of efficient procedures and rules by the Inference Engine is essential in deducting a correct, flawless solution.
- In case of knowledge-based ES, the Inference Engine acquires and manipulates the knowledge from the knowledge base to arrive at a particular solution.
- In case of rule based ES, it :
  - o Applies rules repeatedly to the facts, which are obtained from earlier rule application.
  - o Adds new knowledge into the knowledge base if required.
  - o Resolves rules conflict when multiple rules are applicable to a particular case.
- To recommend a solution, the Inference Engine uses the following strategies :
  1. Forward Chaining
  2. Backward Chaining

#### → 1. Forward Chaining

- It is a strategy of an expert system to answer the question, "What can happen next?"
- Here, the Inference Engine follows the chain of conditions and derivations and finally deduces the outcome. It considers all the facts and rules, and sorts them before concluding to a solution.
- This strategy is followed for working on conclusion, result, or effect. For example, prediction of share market status as an effect of changes in interest rates.

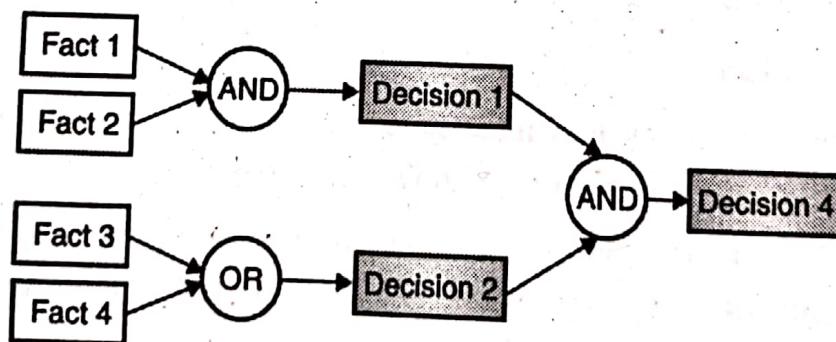


Fig. 5.12.2

#### → 2. Backward Chaining

- With this strategy, an expert system finds out the answer to the question, "Why this happened?"

- On the basis of what has already happened, the Inference Engine tries to find out which conditions could have happened in the past for this result. This strategy is followed for finding out cause or reason. For example, diagnosis of blood cancer in humans.

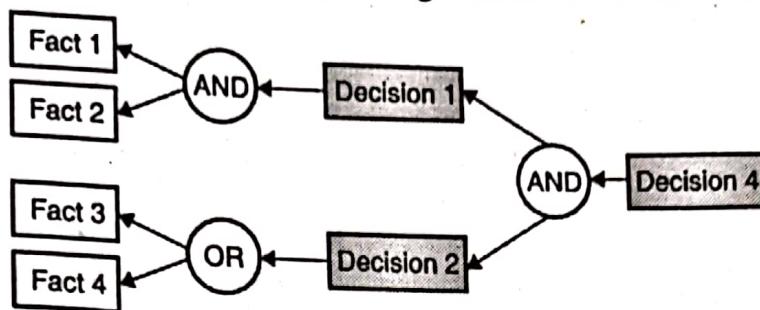


Fig. 5.12.3

### 5.12.3 User Interface

- User interface provides interaction between user of the ES and the ES itself. It is generally Natural Language Processing so as to be used by the user who is well-versed in the task domain.
  - The user of the ES need not be necessarily an expert in Artificial Intelligence.
  - It explains how the ES has arrived at a particular recommendation. The explanation may appear in the following forms :
    - o Natural language displayed on screen.
    - o Verbal narrations in natural language.
    - o Listing of rule numbers displayed on the screen.
  - The user interface makes it easy to trace the credibility of the deductions.
- ☛ **Requirements of Efficient ES user interface**
- It should help users to accomplish their goals in shortest possible way.
  - It should be designed to work for user's existing or desired work practices.
  - Its technology should be adaptable to user's requirements; not the other way round.
  - It should make efficient use of user input.

### ☛ **Expert systems limitations**

No technology can offer easy and complete solution. Large systems are costly, require significant development time, and computer resources. ESs have their limitations which include :

- Limitations of the technology.
- Difficult knowledge acquisition.
- ES are difficult to maintain.
- High development costs.

### **Syllabus Topic : Applications of Expert Systems**

#### **5.13 Applications of Expert System**

**Q. 5.13.1 Explain applications of expert system in detail. (Ref. Sec. 5.13)**

**(5 Marks)**

The Table 5.13.1 shows where ES can be applied.

**Table 5.13.1**

<b>Application</b>	<b>Description</b>
Design Domain	Camera lens design, automobile design.
Medical Domain	Diagnosis Systems to deduce cause of disease from observed data, conduction medical operations on humans.
Monitoring Systems	Comparing data continuously with observed system or with prescribed behavior such as leakage monitoring in long petroleum pipeline.
Process Control Systems	Controlling a physical process based on monitoring.
Knowledge Domain	Finding out faults in vehicles, computers.
Finance/Commerce	Detection of possible fraud, suspicious transactions, stock market trading, Airline scheduling, cargo scheduling.

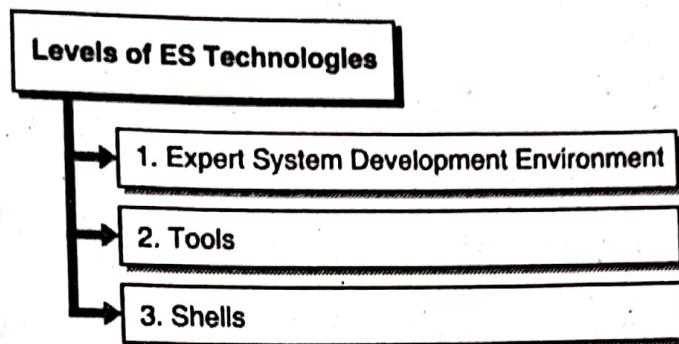
### 5.13.1 Expert System Technology

**Q. 5.13.2 Write application of expert system. (Ref. Sec. 5.13.1)**

**(5 Marks)**

There are several levels of ES technologies available. Expert systems technologies include :

- **1. Expert System Development Environment**
- The ES development environment includes hardware and tools.



**Fig. 5.13.1 : Levels of ES Technologies**

They are :

- o Workstations, minicomputers, mainframes.
- o High level Symbolic Programming Languages such as **LISP** Programming (LISP) and **PROgrammation en LOGique** (PROLOG).
- o Large databases.

#### → **2. Tools**

- They reduce the effort and cost involved in developing an expert system to large extent.
- o Powerful editors and debugging tools with multi-windows.
- o They provide rapid prototyping.
- o Have Inbuilt definitions of model, knowledge representation, and inference design.

#### → **3. Shells**

- A shell is nothing but an expert system without knowledge base. A shell provides the developers with knowledge acquisition, inference engine, user interface, and explanation facility. For example, few shells are given below :
- o **Java Expert System Shell (JESS)** that provides fully developed Java API for creating an expert system.
- o **Vidwan**, a shell developed at the National Centre for Software Technology, Mumbai in 1993. It enables knowledge encoding in the form of IF-THEN rules.

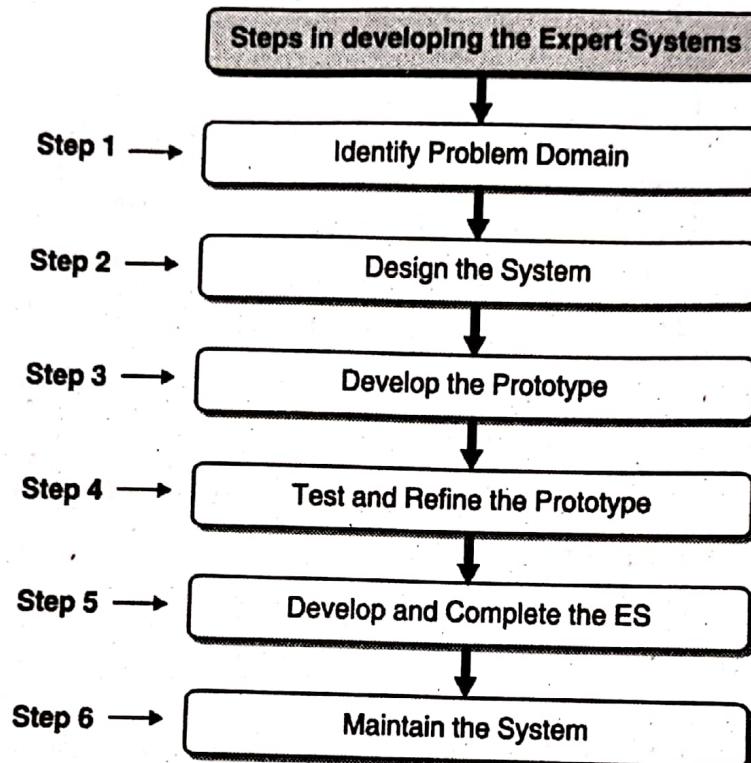
### Syllabus Topic : Development of Expert Systems

#### 5.14 Development of Expert Systems: General Steps

**Q. 5.14.1** Enlist and explain steps of development of expert system.  
(Ref. Sec. 5.14)

**(5 Marks)**

The process of ES development is iterative. Steps in developing the ES include :



**Fig. 5.14.1 : Steps in developing the Expert Systems**

→ **1. Identify Problem Domain**

- The problem must be suitable for an expert system to solve it.
- Find the experts in task domain for the ES project.
- Establish cost-effectiveness of the system.

→ **2. Design the System**

- Identify the ES Technology.
- Know and establish the degree of integration with the other systems and databases.
- Realize how the concepts can represent the domain knowledge best.



### → 3. Develop the Prototype

From Knowledge Base: The knowledge engineer works to :

- Acquire domain knowledge from the expert.
- Represent it in the form of If-THEN-ELSE rules.

### → 4. Test and Refine the Prototype

- The knowledge engineer uses sample cases to test the prototype for any deficiencies in performance.
- End users test the prototypes of the ES.

### → 5. Develop and Complete the ES

- Test and ensure the interaction of the ES with all elements of its environment, including end users, databases, and other information systems.
- Document the ES project well.
- Train the user to use ES.

### → 6. Maintain the System

- Keep the knowledge base up-to-date by regular review and update.
- Cater for new interfaces with other information systems, as those systems evolve.

### ☞ Benefits of Expert Systems

- **Availability** : They are easily available due to mass production of software.
- **Less Production Cost** : Production cost is reasonable. This makes them affordable.
- **Speed** : They offer great speed. They reduce the amount of work an individual puts in.
- **Less Error Rate** : Error rate is low as compared to human errors.
- **Reducing Risk** : They can work in the environment dangerous to humans.
- **Steady response** : They work steadily without getting motionless, tensed or fatigued.

## 5.15 Exam Pack (Review Questions)

### ☞ Syllabus Topic : Introduction to Knowledge Management

- |             |   |                  |
|-------------|---|------------------|
| <b>Q. 1</b> | Explain Knowledge management. (Refer Section 5.1)                             | <b>(5 Marks)</b> |
| <b>Q. 2</b> | Explain knowledge management process. (Refer Section 5.1.1)                   | <b>(5 Marks)</b> |
| <b>Q. 3</b> | Write short note on approaches knowledge management.<br>(Refer Section 5.1.1) | <b>(5 Marks)</b> |

**☞ Syllabus Topic : Roles of People in Knowledge Management**

**Q. 4** What are the role of knowledge management ? (Refer Section 5.2) **(5 Marks)**

**☞ Syllabus Topic : Organizational Learning**

**Q. 5** Write short note on learning organization. (Refer Section 5.3) **(5 Marks)**

**☞ Syllabus Topic : Organizational Transformation**

**Q. 6** Write short note on Organizational transformation. (Refer Section 5.4) **(5 Marks)**

**☞ Syllabus Topic : Knowledge Management Activities**

**Q. 7** Explain knowledge management activities in brief. (Refer Section 5.5) **(5 Marks)**

**☞ Syllabus Topic : Information Technology (IT) in Knowledge Management**

**Q. 8** Explain IT in knowledge management.(Refer Section 5.7) **(5 Marks)**

**☞ Syllabus Topic : Knowledge Management Systems Implementation**

**Q. 9** Write steps involved in knowledge management system implementation.  
(Refer Section 5.8) **(5 Marks)**

**☞ Syllabus Topic : Concepts and Definitions of Artificial Intelligence**

**Q. 10** What is Artificial Intelligence? (Refer Section 5.9) **(5 Marks)**

**☞ Syllabus Topic : Artificial Intelligence Versus Natural Intelligence**

**Q. 11** Differentiate between human intelligence and artificial intelligence.  
(Refer Section 5.10) **(5 Marks)**

**☞ Syllabus Topic : Basic Concepts of Expert Systems**

**Q. 12** Explain basic concepts of expert systems. (Refer Section 5.11) **(5 Marks)**

**Q. 13** What are expert systems? (Refer Section 5.11) **(5 Marks)**

**☞ Syllabus Topic : Structure of Expert Systems**

**Q. 14** Explain components of expert system. (Refer Section 5.12) **(5 Marks)**

**Q. 15** Explain structure of expert systems. (Refer Section 5.12) **(5 Marks)**

**☞ Syllabus Topic : Knowledge Engineering**

**Q. 16** What is Knowledge? (Refer Section 5.12.1) **(5 Marks)**

**Q. 17** Explain forward chaining and backward chaining. (Refer Section 5.12.1.1) **(5 Marks)**

**☛ Syllabus Topic : Applications of Expert Systems**

**Q. 18** Explain applications of expert system in detail. (Refer Section 5.13) **(5 Marks)**

**Q. 19** Write application of expert system. (Refer Section 5.13.1) **(5 Marks)**

**☛ Syllabus Topic : Development of Expert Systems**

**Q. 20** Enlist and explain steps of development of expert system.  
(Refer Section 5.14) **(5 Marks)**

□□□

*Chapter Ends...*